

REMARKS

Claim 1 has been amended to overcome the Examiner's rejections under 35 U.S.C. § 103(a). Each rejection will be addressed separately, in the sections below. Claim 6 has been amended to be in better condition for allowance, by clarifying that the substance to which it refers is the "pH increasing" substance.

35 U.S.C. § 103(a): Grover

The Examiner has rejected claims 1-5, 7 and 14 under 35 U.S.C. § 103(a) as being unpatentable over Grover. Applicants submit that independent claim 1 has been amended to include nonobvious, distinguishing features over the relied upon art.

The Examiner has cited Grover as teaching a CMP slurry that includes the same chemical elements of the present invention as claimed in independent claim 1, including a pH increasing substance to increase the pH level to above 1.5. Grover clearly describes a CMP slurry with a pH level above 3 (see Abstract). This is further specified in Column 6, lines 30-37:

The CMP slurry of the invention must have a pH level from about 3.0 to about 11.0 to be effective. More preferably, the slurry pH level will range from about 3.5 to about 6.0 and most preferably the pH level is from about 3.8 to about 5.5.

Claim 1 has been amended to include a pH level increasing substance that increases the pH level to a value above 1.5 but below 3.0. Hence, the slurry is limited to a pH level *below* 3.0. Since Grover specifically teaches that the pH level of the CMP slurry must be above 3.0, it would not have been obvious to one skilled in the art to produce a CMP slurry with a pH level below 3.0.

Further, Grover teaches that cerium oxides with a pH level of about 1.5 are ineffective as CMP slurries, but become effective when the pH level is increased to about 3.5 (col. 6, lines 21-22). The CMP slurry of the present invention, as claimed in independent claim 1, includes pH levels starting above 1.5, directly contrary to the teachings of Grover. It should be further noted that the present claimed invention achieved polishing results superior to those of the reference,

using pH levels below 3.0, which would not be expected based on the teachings of the reference (see p. 12, Table 1 of the application and Fig. 1 of the reference).

Accordingly, Applicants submit that the relied upon reference for the § 103(a) rejection fails to teach the present invention as claimed in independent claim 1. Since claims 2-5, 7 and 14 depend from claim 1, Applicants submit that, by the same arguments presented above, the relied upon reference for the § 103(a) rejection fails to teach the present invention as claimed in those claims, as well.

35 U.S.C. § 103(a): Farkas

The Examiner has also rejected claims 1-5, 7 and 14 under 35 U.S.C. § 103(a) as being unpatentable over the Farkas et al. patent (US 5,773,364) and the Farkas article (“Oxidation and Etching of Tungsten in CMP Slurries”). The rejection states that it would have been obvious to one skilled in the art at the time of the invention to determine the optimum pH levels from these references.

The Examiner has cited the Farkas patent as describing a slurry comprised of the chemical elements claimed in the present invention. The rejection states that while the Farkas patent fails to describe polishing parameters such as pH level, the Farkas article shows different oxidizing agent concentrations with their pH levels and corresponding etch rates. Applicants submit that the Farkas article does not teach the determination of optimum pH levels as the rejection states. Aside from a column in a table, the only mention of pH levels in the entire article is a general proposition about the pH levels of ferricyanide. Applicants submit that the article does not teach determination of proper pH levels for a CMP slurry, and that it would not have been obvious to one skilled in the art to determine the proper pH levels from a CMP slurry from these references. Applicants submit that the relied upon references for the § 103(a) rejections, singly or combined, fail to teach the present invention as claimed in amended claim 1, claims 2-5, 7 and 14.

35 U.S.C. § 103(a): Farkas in view of Brusie

The Examiner has also rejected claims 6, 8 and 9 under 35 U.S.C. § 103(a) as being unpatentable over the Farkas patent and Farkas article as applied to claim 1, in further view of Brusie et al. Brusie teaches that adding glycine to a slurry increases the dissolution of copper metal. Therefore, the rejection states that it would have been obvious to one skilled in the art to add glycine to the CMP slurries described in the Farkas patent and article. As described above, Applicants submit that the Farkas patent and article do not teach the present invention as claimed in amended claim 1. Accordingly, Applicants submit that the combination of the Brusie reference with the Farkas references fails to teach the present invention as claimed in dependent claims 6, 8 and 9, which depend from claim 1, and contain the same nonobvious features.

35 U.S.C. § 103(a): Farkas in view of Grumbine

The Examiner has also rejected claims 10-13 under 35 U.S.C. § 103(a) as being unpatentable over the Farkas patent and Farkas article as applied to claim 1, in further view of Grumbine et al. Again, Applicants submit that the Farkas patent and article do not teach the present invention as claimed in amended claim 1. Accordingly, Applicants submit that the combination of the Grumbine reference with the Farkas references fails to teach the present invention as claimed in dependent claims 10-13, which depend from claim 1, and contain the same nonobvious features.

Accordingly, Applicants submit that the amended claims 1 and 6 are now in condition for allowance. Further, Applicants submit that all pending claims 1-14 are now in condition for allowance. Applicants respectfully request removal of all rejections.

Please charge any insufficiency or credit any overpayment to Deposit Account No. 02-2666.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE:

IN THE SPECIFICATION

The paragraph starting on line 8 of page 14 has been amended as follows:

The process as shown in Figures 1a to 1c is repeated until, as shown in Figure 1d, the barrier layer 114 is exposed and a metal line [122] 123 remains within the opening 112. The cerium ions in the slurry are selective in that only the material of the metal layer 116 is oxidized, and not the material of the barrier layer 114. The barrier layer 114 is thus used as a polish stop layer which prevents further removal of material.

IN THE CLAIMS

1. (Amended) A chemical-mechanical polishing slurry comprising:
a liquid;
cerium ions as an oxidizer in the liquid, the cerium ions being in a quantity equal to the inclusion of at least 0.02 molar ammonium cerium nitrate in the liquid;
an abrasive in the liquid, the liquid, the cerium ions and the abrasive together having a first pH value; and
a pH increasing substance in the liquid that increases the first pH value to a second pH value above 1.5 and below 3.0.
6. (Amended) The slurry of claim 1 wherein the pH increasing substance is glycine.

FIG. 1a

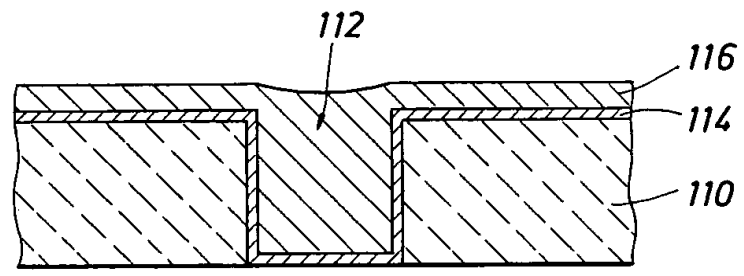


FIG. 1b

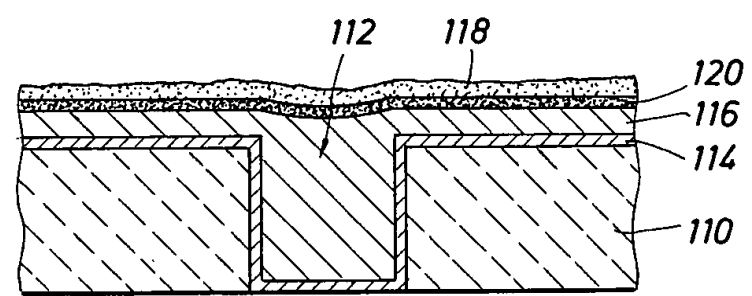


FIG. 1c

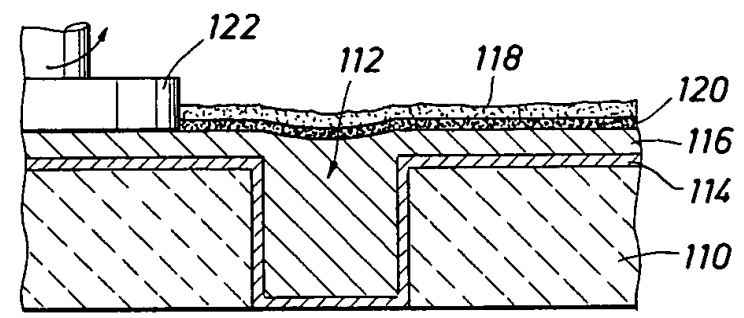


FIG. 1d

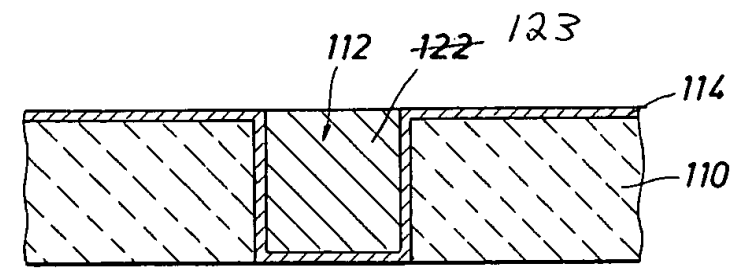


FIG. 1a

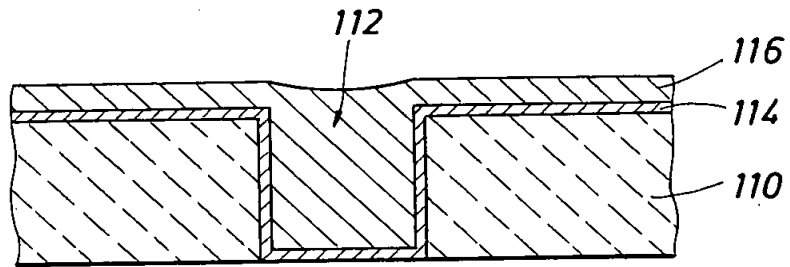


FIG. 1b

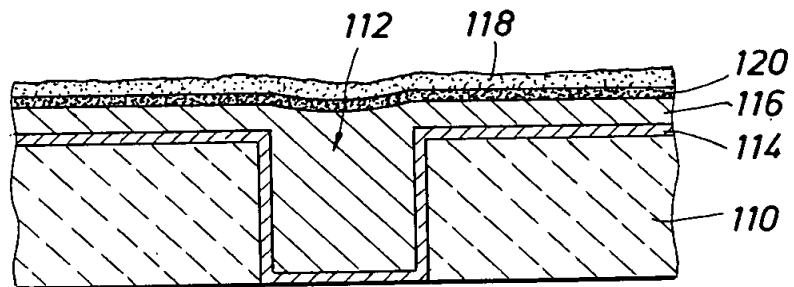


FIG. 1c

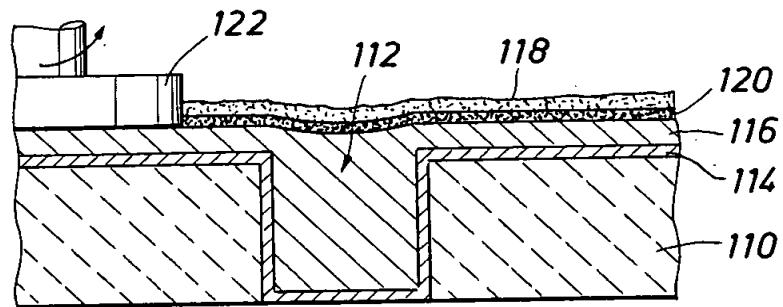


FIG. 1d

